MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2022/2023

EPM1016 – INSTRUMENTATION & MEASUREMENT TECHNIQUES

(TE/RE)

3 JULY 2023
9.00 a.m. - 11.00 a.m.
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This Question paper consists of 5 pages including cover page with 4 Questions only.
2. Attempt **ALL** questions. All questions carry equal marks and the distribution of the marks for each question is given.
3. State all the assumptions clearly.

Question 1

a) Draw a diagram that relates *transducer*, *sensor* and *actuator*.
Then briefly explain each of them. [4 marks]

b) There are 3 types of torques involved in a moving system.
State them and briefly explain each of the torque. [6 marks]

c) Two voltmeters, A and B, are used to measure the potential difference between points X and Y as shown in Figure Q1 below. Determine the real voltage across XY when
i) voltmeter-A (given internal resistance, $R_A = 10k\Omega$) is in use.
ii) voltmeter-B (given internal resistance, $R_B = 20k\Omega$) is in use.
Next, what is the *percentage error* of voltmeter-B due to *loading effect*?
[11 marks]

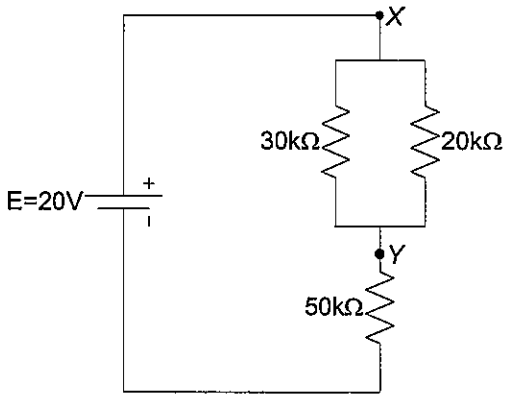

Figure Q1

d) i) Briefly explain *loading effect* in your own words. [2 marks]
ii) From the results that you have obtained from part (c) above, how can you increase the accuracy of your measurement? [2 marks]

Question 2

a) Figure Q2(a) shows a wattmeter and Figure Q2(b) shows a load powered by an AC source. Draw the two methods of connections that are used in the wattmeter to measure the power consumed by the load. Then briefly explain why the wattmeter for both connections provide a higher reading.

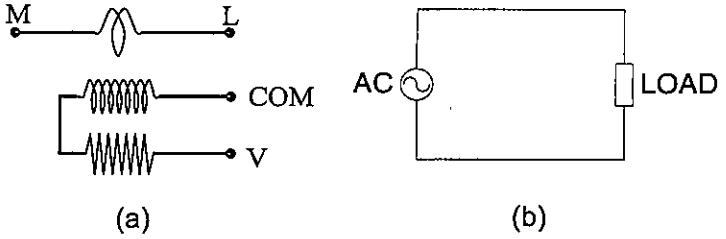

Figure Q2

[4+4 marks]

b) Redraw one of the wattmeter connection in part (a) above by including a *compensating coil* in the connection. Briefly state how the compensating coil helps to compensate the error in the reading of the wattmeter. [2+3 marks]

c) Two wattmeters are connected to measure a balanced inductive 3ϕ load with power factor 0.25 and is known to draw 5A from a 3ϕ 400V supply.

i) Determine the readings of the two wattmeters. [7 marks]

ii) Verify whether the sum of the readings in part (i) is indeed the total load power consumed by the load. [5 marks]

Question 3

a) The bridge circuit in Figure Q3(a) represents an unbalanced bridge. If the galvanometer has a resistance of 40Ω, determine the current through the galvanometer.

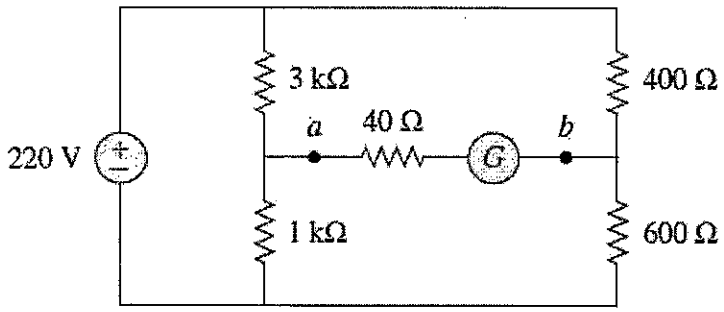

Figure Q3(a)

[12 marks]

b) The AC bridge in Figure Q3(b) is in balance condition, with the following constants: arm AB (R = 500Ω), arm BC (R = 250Ω in series with C = 0.5μF), arm CD (unknown impedance) and arm DA (R = 300Ω in series with L = 16.5mH). The supply frequency is 2kHz. Find the constants of arm CD.

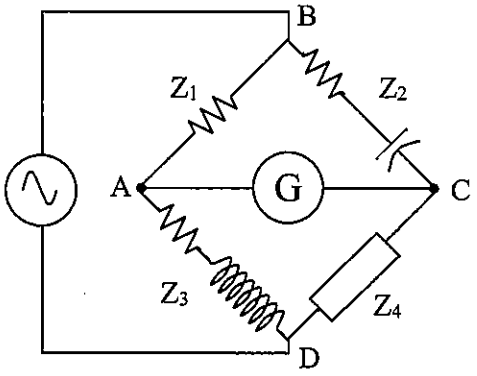

Figure Q3(b)

[13 marks]

Question 4

a) A two-legged core with coils wound is shown in Figure Q4. The winding on the left leg of the core (N_1) has 600 turns, and the winding on the right (N_2) has 200 turns. If the dimensions are as given, determine the flux produced if currents $i_1 = 0.5$ A and $i_2 = 1.0$ A. Assume $\mu_r = 1000$ and constant.

[13 marks]

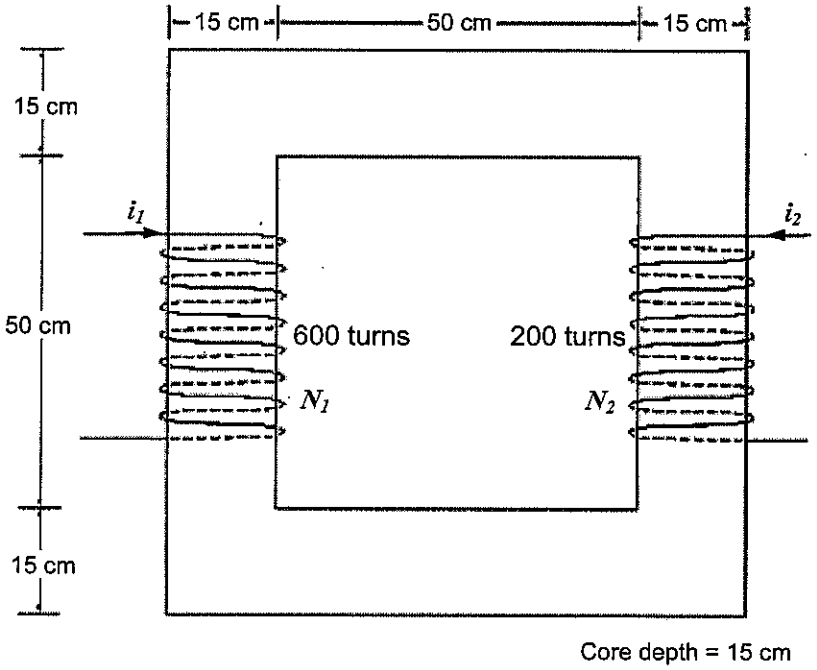

Figure Q4

b) A core displacement of 1mm of an LVDT gives an output of 10mV across its terminals. If the LVDT is connected to a full scale 50V-voltmeter with known amplification factor of 100, determine the

i. sensitivity of the LVDT. [3 marks]

ii. sensitivity of the whole setup. [3 marks]

If the scale of the voltmeter has 80 divisions and the scale can be read accurately up to 1/5 of a division, what is the resolution (in mm) of the instrument? [6 marks]

End of paper